Contract Title

REDUCED RISK PEST MANAGEMENT PROGRAMS FOR ICEBERG AND LEAF LETTUCE IN CALIFORNIA

Contract No.: 97-0282

Principal Investigator:
Edward A. Kurtz
California Lettuce Research Board

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ABSTRACT

The information presented in this report is a result of a cooperative effort involving research on Integrated Pest Management projects on downy mildew and leafminers funded by the California Lettuce Research Board and the California Department of Pesticide Regulation under contract No. 97-0282. The objectives of the various phases of research conducted under this contract were accomplished, and the following general results were obtained: 1) Downy mildew: a) Workshops were held in both the coastal and desert regions, and new cooperators participated in the implementation phase of this project on both iceberg and romaine lettuce, which resulted in an overall reduction in the total number of fungicide applications and b) Experimental iceberg lettuce cultivars with multiple downy mildew characteristics were included in trials in the Salinas area, and data obtained indicate that they contain resistance characteristics to existing strains of downy mildew; and 2) Leafminer: a) Data were collected to compare the impact of IPM and grower standard treatments on three types of iceberg lettuce packs at harvest in the Salinas area; and b) A workshop was held in Santa Maria and two trials established on iceberg lettuce in that area.

EXECUTIVE SUMMARY

The following summaries are provided for the various projects and tasks conducted under contract No. 97-0282.

Project Supervision: Task 1 - California Lettuce Research Board (CLRB)
The objectives of this task were to provide overall supervision to the other tasks under this contract. The Manager of the CLRB provided the overall supervision for this project, which included keeping the DPR project coordinator, informed of all meetings and related activities. Project supervision also included keeping all subcontractors informed of the requirements of the contract and the timelines necessary to meet all contractual obligations. The CLRB Manager established contracts with each subcontractor, requested summaries of quarterly expenditures and accomplishments, prepared all quarterly reports and invoices, distributed project funds to individual subcontractors, and supervised the preparation of the final report.

Downy Mildew Project: Task 2 - Subtask A - Western Farm Service, Inc. (WFS)
The objective of this subtask was to expand the implementation of the disease risk assessment model with weather forecasting system on iceberg lettuce to the desert regions in the fall/winter of 1998-99. Workshops were held in the Imperial Valley and Yuma, Arizona areas in September and October of 1998, and four implementation trials were established in the Imperial Valley/Bard regions with additional trials in Yuma, an area with similar production characteristics to the Imperial Valley. WFS representatives established weather stations at all trial sites, maintained daily communication with each individual grower, and coordinated the application of fungicides to correspond to the development of downy mildew. The results of these trials indicated an overall savings in fungicide applications in one, or more, trials in both the Imperial Valley/Bard and Yuma areas.

Downy Mildew Project: Task 2 - Subtask B - Western Farm Service, Inc. (WFS)
The objective of this subtask was to expand the implementation of the disease risk assessment model with weather forecasting system on romaine lettuce to the coastal and desert regions in the summer/fall/winter of 1998-99. Workshops were held in the Salinas, Imperial Valley, and Yuma, Arizona areas in September, October, and November of 1998, and four implementation trials were established (2 in Salinas and 2 in Bard). WFS representatives established weather stations at all trial sites, maintained daily communication with each individual grower, and coordinated the application of fungicides to correspond to the development of downy mildew. The results of these trials indicated an overall savings in fungicide applications in one, or more, trials in both the Salinas and Bard areas.

Downy Mildew Project: Task 2 - Subtask C - University of California (UC) and United States Department of Agriculture (USDA)
The objective of this subtask was to evaluate new advanced UC and USDA iceberg lettuce breeding lines with multiple downy mildew disease resistance characteristics in the Salinas region in 1998 and 1999. Two trials were conducted in 1998 and a lack of disease development precluded the opportunity to obtain data. Two trials were planted in the spring of 1999, and individual UC and USDA new advanced iceberg lettuce breeding lines displayed resistance to existing field strains of downy mildew.

Downy Mildew Project: Task 2 - Subtask D - Western Farm Service, Inc. (WFS) and the California Lettuce Research Board (CLRB)
The objective of this subtask was to expand implementation of the disease risk assessment model with weather forecasting system on iceberg lettuce in the coastal region in the summer/fall of 1998. The primary objective of this subtask was to reimburse WFS and the CLRB for one-half of the funds that they had obligated for the expansion of the implementation of the downy mildew model. Based on conversations with representatives of the California Department of Pesticide Regulation the reimbursement process was expanded to include growers in the desert region, who were also a part of this contract. WFS developed a list of growers involved in this process, and there were 15 grower trials involved on either iceberg and/or romaine lettuce in either the coastal or desert lettuce production regions.

Leafminer Project: Task 3 - Subtask A - University of California Cooperative Extension (UCCE)
The objective of this subtask was to develop information on the impact of two (2) leafminer treatment regimes (i.e., Integrated Pest Management (IPM) and Grower Standard) on three (3) types of iceberg lettuce packs at harvest in the Salinas region in the summer/fall of 1998. Four trials were conducted and information was obtained on the comparison of the two treatment regimes and three lettuce packs at harvest (i.e., naked, wrapped, and bulk). The overall results indicate that naked lettuce had significantly more leafminers at harvest than wrapped which had more than lettuce harvested as a bulk pack. Data on the impact of the grower standard and IPM treatment regimes was less clear with neither treatment consistently affecting the number of leafminers emerging at harvest.

Leafminer Project: Task 3 - Subtask B - University of California Cooperative Extension (UCCE)
The objective of this subtask was to expand implementation of the leafminer project on iceberg lettuce to Santa Maria in the spring/summer of 1999. A workshop was held in the Santa Maria region in March of 1999 and two implementation trials were established on iceberg lettuce in that region to compare grower standard treatments to IPM treatments. One trial was lost when it was inadvertently oversprayed by the applicator. The data obtained from the second trial indicates that under low pest population conditions there were no differences in pest control even though there was one less insecticide application to the IPM area.

CALIFORNIA LETTUCE RESEARCH BOARD
SUMMARY OF ACTIVITIES
TASK 1 - PROJECT SUPERVISION

INTRODUCTION

The objective of this task was to provide overall supervision to the other tasks under this contract. The Manager of the California Lettuce Research Board (CLRB) provided the overall supervision for this project, which included keeping the Department of Pesticide Regulation (DPR) project coordinator, informed of all meetings and related activities. Project supervision also included keeping all subcontractors informed of the requirements of the contract and the timelines necessary to meet all contractual obligations. The CLRB Manager established contracts with each subcontractor, requested summaries of quarterly expenditures and accomplishments, prepared all quarterly reports and invoices, distributed project funds to individual subcontractors, and supervised the preparation of the final report.

MATERIALS AND METHODS

Contracts were developed by CLRB Manager for each subtask and submitted for approval to the appropriate individual or institution. The CLRB Manager kept in frequent contact with the DPR project coordinator and the individual supervisors of each subtask to ensure that all subtasks were being conducted in a manner that would meet the contractual obligations of the project. The contact was maintained through correspondence, telephone conversations, fax transmissions, and meetings. The CLRB Manager also assisted, where appropriate, in establishing meetings and meeting sites and in providing mailing lists of lettuce growers where appropriate. In addition, CLRB Manager submitted all quarterly reports and invoices, prepared portions of the final report, and supervised the preparation of each subtask report to ensure that they met the requirements of the contract.

RESULTS AND DISCUSSION

As a result of the coordination provided by the CLRB Manager, individual supervisors of subtasks submitted their quarterly reports and records of expenditures on time, which were forwarded for payment to the DPR project coordinator. The CLRB Manager dispersed funds received from the DPR to each individual subcontractor in a timely manner consistent with the receiving of funds from the DPR. The data from each individual subcontract is provided as a separate report, and the CLRB manager reviewed each report to ensure that they met the requirements of the contract.

SUMMARY AND CONCLUSIONS

The primary objective of this task was to provide overall supervision for the various subtasks associated with this contract. This was primarily accomplished through frequent communication with the individual subcontractors involved in the project. In conclusion, it is felt that although data were not available from each individual trial, that the primary objectives of each subcontract were met, which has resulted in expanding the implementation phases of both the downy mildew and leafminer projects and in the development of new potential downy mildew resistant cultivars for iceberg lettuce.

TASK 2, SUBTASK A - DOWNY MILDEW PROJECT
EXPAND ICEBERG IMPLEMENTATION TO THE DESERT REGION

INTRODUCTION

The purpose of this subtask is to expand implementation of the disease risk assessment model with weather forecasting system on iceberg lettuce to the desert regions. Van Bruggen and Scherm conducted work from 1991 to 1996, which was funded by the California Iceberg Lettuce Advisory Board to develop a risk assessment model to forecast downy mildew risk on iceberg lettuce in the coastal valleys of California. Using this information, a model was created and validated by Thomas in cooperation with Adcon Telemetry, Western Farm Service, the California Iceberg Lettuce Advisory Board and the Iceberg Lettuce Integrated Pest Management and Risk Assessment Group. Following its validation, a structured hands-on educational approach was applied to implementing this model into commercial Iceberg operations in the coastal areas of California. The same approach was expanded to the desert areas as the purpose of Subtask A.

MATERIALS AND METHODS

Western Farm Service-owned Adcon Telemetry weather stations were placed in individual lettuce fields in Bard, or Imperial, CA at planting. Weather conditions were monitored and disease risk was calculated daily. Results were reported to the grower and the pest control advisor daily by fax. Each field was split in half. Half was sprayed according to the grower's stand spray schedule; the other half was sprayed according to the model. Weekly scouting was conducted to evaluate the performance of each strategy. Workshops were held in Yuma, Arizona on September 30, and in Holtville, CA on October 1, 1998 to present the program and recruit participants to the project. All of the available information on the downy mildew project including comparisons of treatment schedules based on either a disease risk assessment model with weather forecasting or a grower standard program was presented. A classroom session was held at the beginning (December 10), middle (January 21), and end (May 18) of the project to train participants and compare the results from the various sites. Weather forecasts provided by Fox Weather were incorporated into the model to determine the optimal timing of fungicide sprays.

RESULTS AND DISCUSSION

There were 15 attendees at the Yuma meeting and 12 attendees in Holtville. Two fields in Bard and two fields in Imperial were established in the project. The model called for three sprays in one of the Bard fields. This was the same number as used in the grower's standard program, but the timing was different between the two. Crop quality was improved by timing the sprays according to the model. In the second Bard field, the model called for only one spray. The grower standard program used two sprays. In Imperial, both fields used two sprays for the grower standard program. In one field, the model called for only one spray in the other the model called for no sprays. In all cases the fields had no or negligible downy mildew at harvest.

An average of one spray was saved at each field by using the model. In December, risk was quite high and sprays were applied. In neighboring blocks or grower standard blocks that did not receive a spray, downy mildew started to appear. This indicates that not only the number of sprays but also the timing of the sprays is critical. Other fields generally had to put on more sprays once disease became established. January and February exhibited low disease pressure. That is the period when sprays were saved. Mildew pressure started to increase again in April, but the crops were harvested, making additional sprays not necessary. Historically, growers in this area do not spray until mildew is observed in the field, but then spray repeatedly in an effort to eradicate it. Last year most of these growers sprayed four or more times using this strategy. Six additional trials were conducted in the Yuma region. The general results were equal to those obtained in California with an average savings of one spray over the standard in each trial. At savings of $30 per acre per spray, all of the participants felt that this technology paid for itself. All of the participants have signed up for the same approach for next year.

SUMMARY AND CONCLUSIONS

The objective of this subtask was to expand the implementation of the disease risk assessment model with weather forecasting system on iceberg lettuce to the desert regions in the fall - winter of 98-99. Workshops were held in the Yuma and Imperial Valley regions on September 30 and October 1 of 1998. Four implementation trials were established in that region, which included two in Bard, and two in Imperial. Western Farm Service representatives established weather stations in the four trial sites, maintained daily communication with each individual grower, and coordinated the application of fungicides to correspond to the development of downy mildew. The results of these trials indicated overall savings of four total fungicide applications, and average savings of one application for each trial. In one case no downy mildew fungicides were needed during the production season.

CALIFORNIA LETTUCE RESEARCH BOARD
Franklin Dlott

TASK 2, SUBTASK B - DOWNY MILDEW PROJECT
EXPAND IMPLEMENTATION SYSTEM TO ROMAINE LETTUCE

INTRODUCTION
The purpose of this subtask is to expand implementation of the disease risk assessment model with weather forecasting system on romaine lettuce to the desert regions. Van Bruggen, and Scherm conducted work from 1991 to 1996, which was funded by the California Iceberg Lettuce Advisory Board to develop a risk assessment model to forecast downy mildew risk on iceberg lettuce in the coastal valleys of California. Using this information, a model was created and validated by Thomas in cooperation with Adcon Telemetry, Western Farm Service, the California Iceberg Lettuce Advisory Board, the Iceberg Lettuce Integrated Pest Management and Risk Assessment Group. Following its validation, a structured hands-on educational approach was applied to implementing this model into commercial Iceberg operations in the coastal areas of California. The model was applied to romaine lettuce in the coastal and desert areas in 1998 and 1999.

MATERIALS AND METHODS
Western Farm Service-owned Adcon Telemetry weather stations were placed in individual lettuce fields in Bard or Salinas, CA at planting. Weather conditions were monitored and disease risk was calculated daily. Results were reported to the grower and the pest control advisor daily by fax. Each field was monitored for incidence of downy mildew in plants sprayed according to the model or not sprayed. Weekly scouting was conducted to evaluate the performance of the model. Workshops were held in Yuma, AZ on September 30, in Holtville, CA on October 1, and in Salinas, CA on November 13, 1998 to present the program and recruit participants to the project. All of the available information on the downy mildew project, including comparisons of treatment schedules based on either a disease risk assessment model with weather forecasting or a grower standard program was presented. A classroom session was held at the beginning (December 10), middle (January 21), and end (May 18) of the project to train participants and compare the results from the various sites. Weather forecasts provided by Fox Weather were incorporated into the model to determine the optimal timing of fungicide sprays.

RESULTS AND DISCUSSION
Two fields in Bard and two fields in Salinas were established in the project. The model called for three sprays in all of the fields. However, the latter sprays were not needed according to unsprayed plants since romaine lettuce becomes less susceptible to disease as it ages. Since the growing period is significantly shorter (40 to 50 days compared to 70 to 100 days) and because young romaine is very susceptible, it appears that the initial triggers in the model should be modified over those already established for iceberg lettuce.

An average of one spray was saved at each field by using the model. By using the downy mildew risk combined with growth stage, it was possible to spray romaine only when a spray was needed. All of these trials occurred during periods of relatively high pressure, but the lettuce did not exhibit high levels of disease since sprays controlled disease early and disease susceptibility decreases at maturity.

SUMMARY AND CONCLUSIONS

The objective of this subtask was to expand the implementation of the disease risk assessment model with weather forecasting system on romaine lettuce to the desert and coastal regions in 1998-99. Workshops were held in Yuma, AZ on September 30, in Holtville, CA on October 1, and in Salinas, CA on November 13, 1998, to present the program and recruit participants to the project. Four implementation trials were established, which included two in Bard and two in Salinas. Western Farm Service representatives established weather stations in the four trial sites, maintained daily communication with each individual grower, and coordinated the application of fungicides to correspond to the development of downy mildew. The results of these trials indicated overall savings of four total fungicide applications and an average savings of one application for each trial.

TASK 2, SUBTASK C – DOWNY MILDEW PROJECT
EVALUATIONS OF ICEBERG BREEDING LINES IN THE SALINAS REGION

INTRODUCTION

Downy mildew is currently the most serious foliar disease of lettuce in California. The fungus that incites the disease causes damage to the lettuce crop that is controlled by the genetic make-up of the host lettuce plant, and of the disease organism. They are modified by the environmental conditions during the production period, and by the defense against the organism mounted by the grower, including the fungicides applied to the crop, and the time and frequency of application. This study assumed three things: 1) different genotypes would react differently to the organism, 2) methods of treatment would modify the reaction, and 3) environmental conditions would modify the reaction. The work was designed to test these assumptions. A large body of research literature addresses various aspects of the nature of the disease organism, the host lettuce species, and the relation between them (Ryder 1999).

MATERIALS AND METHODS

The lettuce materials that were tested consisted of five advanced iceberg lettuce breeding lines, three provided by USDA-ARS, Salinas, and two by University of California, Davis. Two lines from each source were tested in each trial; the UC lines were the same for three trials, while two USDA lines were used in the first two trials, and another similar line was substituted for one original line in the second pair of trials. The UC lines were UC 9812 and UC 9825. Insufficient seed remained of UC 9825 for the fourth trial, so the cultivar Calmar was substituted. USDA lines used in Trials 1 and 2 were 96-418-4M and 96-583-4M, and in Trials 3 and 4 were 96-445-2M and 96-583-4M.

Two trial formats were used. In two trials planted in late summer, 1998, plantings were in split fields. One section of each trial was planted in the portion of the field treated according to the grower's decisions on timing, frequency, and materials. The other section was planted in the portion of the field treated with one of several options, selected by the grower, developed by the Downy Mildew Risk Assessment Model team. The purpose in these two trials was to determine the interactive effect of the treatment protocol and the resistance level. In two trials planted in the spring and summer of 1999, plantings were made in single treatment protocol fields, i.e. according to the grower's choice. The plantings were made without knowledge of the specific protocols used.

Each plot consisted of four breeding lines, planted in 25-foot double row beds and replicated twice. These were all planted with Planet, Jr., hand pushed planters in rows marked by the grower's planting rig. The grower handled all subsequent farming practices.

The number of plants in each 25-foot bed section was counted. In two trials, post-harvest plant counts were made to estimate harvest percentage of each line and the field cultivar. Counts of plants with downy mildew lesions were made in each 25-foot bed section, and the percentage of plants infected was calculated.

Where appropriate the data were analyzed statistically by standard procedures.

RESULTS AND DISCUSSION

Trial 1 (Bruce Church, Harris Lot 8, Plant 7/31/98, Field cultivar- Jupiter, Observed early October)
Counts of the number of plants in each 25-foot bed in locations Lot 8-1 and 8-2 were made. No downy mildew lesions were observed in any part of the field, and no further assessment was made.

Trial 2 (Steinbeck Country Huntington Farms, Freyer Lot 80, Plant 8/12/98, Field cultivar- Sharpshooter, Observed 10/28/98)
Counts of the number of plants in each 25-foot bed in Locations 80-1 and 80-2 were made. There was evidence in the field of an earlier downy mildew infection, but lesions were old and confused with other necrotic deterioration of the leaves. Inspection of the plants in both locations showed only one lesion on one plant in one bed. No further assessment was made.

Trial 3 (ConGro, Cunha Lot 4, Plant 5/6/99, Field cultivar- Sharpshooter, Observed 7/16/99)
This was part of a larger trial planted for other purposes. A substantial downy mildew infection was observed in the field; therefore, downy mildew readings as well as plant counts were taken. Three levels of infection were observed (Table 1). UC 9812 showed a high level of resistance. USDA 96-445-2M and 96-583-4M showed a moderate level of resistance. UC 9825 also was moderately resistant, but at a slightly higher level of infection. The field cultivar, Sharpshooter was highly susceptible. The harvest percentage was similar for all lines and was unaffected by the downy mildew incidence.

Trial 4 (Triangle Farms, Jarvis Lot 1, Plant 6/14/99, Field cultivar- Sharpshooter, Observed 8/23/99)
This was also part of a larger trial. Downy mildew severity varied in different parts of the field; the level in the DPR part of the trial was moderate. The level of infection for the breeding line varied in a similar manner to Trial 3 (Table 1). UC 9812 again showed the highest level of resistance, while the two USDA lines were slightly less resistant. The substituted Calmar reacted similarly to Sharpshooter. This section of the field was harvested for bulk use; differences among lines are obscured since nearly all heads are harvested regardless of size and conformation. Therefore, no harvest data is presented.

DISCUSSION

Trials 3 and 4, in which downy mildew reaction could be reported, indicated in both cases that UC 9812 had the highest level of resistance. This was due to the presence of a highly effective single gene for downy mildew resistance. UC 9825 also has a single gene for resistance that was less effective. The USDA lines owe their moderate level of resistance to several genes of individual small effect transferred from the cultivar Iceberg. The effect of the various levels of resistance had essentially no effect on harvest percentage, in the one trial in which that was relevant.

Unfortunately, the 1998 trials, in which the effect of method of fungicidal treatment was to be compared, did not afford that opportunity, since the fields were free of mildew.

SUMMARY AND CONCLUSIONS

Four trials were planted of downy mildew resistant iceberg lettuce type breeding lines. Two trials were planted in late summer, 1998, to compare the effect of single gene and multiple resistances under two protocols of fungicidal treatment. There was little or no downy mildew in either trial, so no assessment could be made.

Two trials were planted in summer, 1999, to compare the resistances under a fungicidal treatment protocol uniform for the entire field. These revealed levels of response to the disease corresponding to the genetic basis for resistance. One line, UC 9812, has a highly effective single gene for resistance, and was most resistant in both trials. The two USDA lines, with a lower level of resistance due to multiple genes of individual small effect, showed moderate resistance in both trials. Line UC 9825, in trial 3 only, was equivalent to the USDA lines. Its single gene is not as effective as that in UC 9812. The cultivars carry single genes that are no longer effective against the fungus, and reacted as susceptible entities.

REFERENCES

Ryder, E.J. 1999. Lettuce, Endive and Chicory. CABI Publishing, Wallingford, UK.

Table 1. Reaction to lettuce downy mildew infection of four resistant breeding lines in two field trials in 1999 in the Salinas Valley.

Line	Trial 3		Trial 4
	% Mildew	% Harvest	% Mildew
UC9812	4.35	96.9	4.1
UC9825	69.40	92.2	-
96-445-2M	53.30	87.4	9.4
96-583-4M	62.20	89.0	5.1
Sharpshooter	100.00	93.3	29.9
Calmar	-	-	33.8

TASK 2, SUBTASK D - DOWNY MILDEW PROJECT
EXPAND ICEBERG IMPLEMENTATION TO THE COASTAL REGION

INTRODUCTION

The purpose of this subtask is to expand implementation of the disease risk assessment model with weather forecasting system on iceberg lettuce to the coastal regions in the summer/fall of 1998. Van Bruggen and Scherm conducted work from 1991 to 1996, which was funded by the California Iceberg Lettuce Advisory Board to develop a risk assessment model to forecast downy mildew risk on iceberg lettuce in the coastal valleys of California. Using this information, a model was created and validated by Thomas in cooperation with Adcon Telemetry, Western Farm Service, the California Iceberg Lettuce Advisory Board, the Iceberg Lettuce Integrated Pest Management and Risk Assessment Group. Following its validation, a structured hands-on educational approach was applied to implementing this model into commercial Iceberg operations in the coastal areas of California.

MATERIALS AND METHODS

Western Farm Service-owned Adcon Telemetry weather stations were placed in individual lettuce fields in Salinas or Lompoc CA at planting. Weather conditions were monitored and disease risk was calculated daily. Results were reported to the grower and the pest control advisor daily by fax. Each field was split in half. Half was sprayed according to the growers stand spray schedule; the other half was sprayed according to the model. Weekly scouting was conducted to evaluate the performance of each strategy. Workshops were held in Yuma, AZ on September 30, in Holtville, CA on October 1, and in Salinas, CA on November 13, 1998 to present the program and recruit participants to the project. All of the available information on the downy mildew project, including comparisons of treatment schedules based on either a disease risk assessment model with weather forecasting or a grower standard program was presented. Weather forecasts provided by Fox Weather were incorporated into the model to determine the optimal timing of fungicide sprays.

RESULTS AND DISCUSSION

Two fields in Lompoc and thirteen fields in Salinas were established in the project. The model did not reduce the number of sprays at ten sites, but improved crop quality at most of those probably due to differences in application dates. The model saved a spray at five of the sites, one of which it saved two sprays. In individual fields, fungicide resistance was suspected and is being investigated, indicating that the level of control was a result in failure of the fungicide to perform, not a failure of the model approach. This season was the wettest on record in 50 years and is representative of the worse case scenario. In most cases, using the model to determine timing of the sprays improved crop quality during extremely high disease pressure. One grower documented a 20% increase in yield and quality by using the model.

SUMMARY AND CONCLUSIONS

The objective of this subtask was to expand the implementation of the disease risk assessment model with weather forecasting system on iceberg lettuce to the coast region in the summer/fall of 98. Workshops were held in Yuma, AZ on September 30, in Holtville, CA on October 1, and in Salinas, CA on November 13, 1998, to present the program and recruit participants to the project. Fifteen implementation trials were established in that region, which included 13 in Salinas and 2 in Lompoc. Western Farm Service representatives established weather stations in the 15 trial sites, maintained daily communication with each individual grower, and coordinated the application of fungicides to correspond to the development of downy mildew. The results of these trials indicated overall savings of six total fungicide applications and an improvement in crop quality in most of the trials. This season was the wettest on record in 50 years and is representative of the worse case scenario. In most cases, using the model to determine timing of the sprays improved crop quality during extremely high disease pressure. One grower documented a 20% increase in yield and quality by using the model.

LEAFMINER PROJECT

TASK 3, SUBTASK A – PURPOSE: TO SUPPLEMENT THE EFFORTS OF THE CENTRAL COST VEGETABLE IPM PROGRAM IN SANTA MARIA AND TO PROVIDE ADDITIONAL INFORMATION ABOUT THE IMPACT OF THE PROGRAM ON VARIOUS PACK TYPES OF LETTUCE

INTRODUCTION

Leafminers have been the pre-dominate insect pest in iceberg and leaf lettuce in the coastal and central coastal valleys of California during the last ten years. Populations became so high that no insecticide program was effective and quality was being compromised. In 1997, the CLRB, in conjunction with local lettuce and celery producers, the private sector (both pest control companies and pest control advisors) and the University of California Cooperative Extension, formed a multi-organizational cooperative program to develop control strategies for this pest. The emphasis was on reducing the amount of chemical pesticide applied combine with the increased use of alternative control measures. This group was funded by the Pew Charitable Trusts for a three-year demonstration and implementation program called the Central Coast Vegetable IPM Program (CCVIPMP), supplementing the CLRB funded research program.

The purpose of this work was to supplement the efforts of the CCVIPMP in both helping to expand their work into the Santa Maria area and to provide additional information about the impact of their program on the various pack types of lettuce: naked pack, wrapped lettuce, and bulk. These efforts were initiated in the summer of 1998 and completed in the summer of 1999. The leafminer pressure during this period was less than had been seen in previous years, perhaps due in part to the effects of the El Nino weather pattern gripping California during that period.

MATERIALS AND METHODS

Samples were collected from four head-lettuce fields at harvest that were part of CCVIPMP. These fields had been divided into "treatments" that were subjected to either 'IPM' or 'Grower Standard' pesticide regimes as outlined below. The two pesticide regimes were chosen by each PCA for each field from pesticide menus as shown in Table 1, which had been developed by the management team of the CCVIPMP. Spray records from individual fields are presented in the Results section along with data analysis.

TABLE 1. Insecticide menu by pest for "Standard" and "IPM" head lettuce treatments.

Pest	"Standard"	"IPM"
Pea Leafminer Larvae	Agrimek Dimethoate Neemix Success Trigard	Agrimek Neemix Success Trigard
Pea Leafminer Adults	Pyrethroids	No treatments
Aphids	Admire Provado Diazinon Dimethoate Lannate Orthene	Admire Provado Orthene ♦
Loopers Armyworms Corn Earworms	Bts Confirm Lannate Larvin Pyrethroids Success	Bts Confirm Success Larvin ♦
Lygus	Pyrethroids	Pyrethroids ♦

♦ Indicates materials that may be used in "IPM" if pest reaches economic thresholds.

DATA COLLECTION

Twenty mature marketable lettuce plants were collected from each field, ten from each pesticide regime. The pesticide regime was replicated twice at Castroville, Blanco, and King City and therefore sub-samples were taken from each replicate. The outer leaves were removed from whole heads and discarded leaving just the marketable head with its wrapper leaves. This reflected a "naked pack", so named because nothing is added to the lettuce as it goes into the carton. The frame leaves were then striped off and collected to get to the pack type known as a "wrapped pack". These heads would normally receive an individual plastic wrap in the field. The frame leaves that were the difference between the naked and wrap pack composed the sample for the naked pack. The wrapper leaf from the wrap pack was stripped as well as one to two other leaves to reflect a "bulk pack". These leaves were collected to form the wrapped sample.

The remaining head of lettuce, usually packed into bulk-bins, composed the bulk sample, which was quartered to prevent rotting. Each lettuce plant was divided into these three 'pack type' samples; naked, wrapped, and bulk; and each sample was placed into a 5-gallon plastic bucket-cage fitted with a yellow sticky card and porous top. The cages were set into a temperature-controlled space (between 80°F and 60°F) for six to eight weeks to allow leafminers and leafminer parasites to complete their development, emerge as adults and fly to and be captured by the yellow stick card.

Sticky cards were evaluated for leafminers and parasites. All of the leafminers were found to be L. huidobrensis, while two leafminer parasites, Diglyphus sp. and Halticoptera circulus were found. The leafminer data were analyzed using SuperAnova v. 1.11 (Abacus Concepts Inc.) on a Macintosh Computer. Anova tables were generated for each of the three samples collected per plant, but the graphs show the leafminer population by the three industry pack types. While parasites were found on at least some samples at all sites except the Blanco, there were insufficient numbers to warrant statistical analysis.

SITE SELECTION AND DESCRIPTION

Sites were selected to include fields from different parts of the lettuce growing regions of the Salinas Valley during mid-season. Sites at Blanco, Spreckels and Castroville were commercially harvested for lettuce cartons while the site at King City was harvested for bulk.

Blanco ~16.5 Acres,	Variety —Columbia planted June 2, 1998 harvest dates: August 5 through August 11, 1998, furrow irrigation
Spreckles ~14.8 Acres	Variety— Premiere planted June 14, 1998 harvested August 21, 1998, drip irrigated
Castroville ~11 Acres	Variety —Dole proprietary planted June 17, 1998 harvest dates August 24 through 26, 1998, overhead sprinkler irrigation
King City ~10 Acres	Variety —Venus and Diamond planted July 18, 1998 harvested Sept 25, 1998, furrow irrigation

RESULTS

TABLE 2. Pesticide Treatments for Blanco Head Lettuce

Date	Standard	IPM
7-1-98	Agrimek 0.15 EC 8 oz. Pounce 25 WP 8 oz. Orthene 75 SP 1.33 lbs. Rovral 2 pts. Maneb 75DF 2 lbs. Silwet L-77 2 oz/100 gal.	Agrimek 0.15 EC 8 oz. Success 8 oz. Provado 1.6 3.75 oz. Rovral 2 pts. Maneb 75DF 2 lbs. Silwet L-77 2 oz/100 gal.
7-12-98	Orthene 75S 1.33 lbs. Pounce 25WP 8 oz. Manex 3.2 pts. Nu-Film P 4oz./100 gal.	Orthene 75S 1.33 lbs. Pounce 25WP 8 oz. Manex 3.2 pts. Nu-Film P 4oz./100 gal.
7-25-98	Lannnate SP 1 lb. Agrimek 0.15EC 8 oz. Provado 1.6 3.75 oz. Nutri-phite 3 pts. Silwet L-77 2 oz/100 gal.	Pounce 25WP 8 oz. Agrimek 0.15EC 8 oz. Provado 1.6 3.75 oz. Success 8 oz. Nutri-phite 3 pts. Silwet L-77 2 oz/100 gal.
7-30-98	Pounce 25 WP 8 oz. Nutri-phite 3 pts.	Nutri-phite 3 pts.

TABLE 3. ANOVA results for Blanco

Type III Sums of Squares

Source	df	Sum of Squares	Mean Square	F-Value	P-Value
treatment * pack	2	10465.833	5232.917	11.800	.0001
treatment	1	12326.667	12326.667	27.796	.0001
pack	2	33643.433	16821.717	37.932	.0001
rep	1	3024.600	3024.600	6.820	.0117
Residual	53	23504.200	443.475		

Dependent: leafminers

Means Table
Effect: treatment * pack
Dependent: leafminers

	Count	Mean	Std. Dev.	Std. Error
IPM, bulk	10	1.100	1.853	.586
IPM, naked	10	88.900	46.228	14.618
IPM, wrap	10	26.700	21.863	6.914
STD, bulk	10	.600	1.075	.340
STD, naked	10	24.900	17.842	5.642
STD, wrap	10	5.200	3.120	.987

Means Table
Effect: treatment
Dependent: leafminers

	Count	Mean	Std. Dev.	Std. Error
IPM	30	38.900	47.103	8.600
STD	30	10.233	14.734	2.690

Duncan New Multiple Range
Effect: treatment
Dependent: leafminers
Significance level: .05

	Count	Mean		
STD	30	10.233	a	
IPM	30	38.900		b

All were significantly different at this level.

Means Table
Effect: pack
Dependent: leafminers

	Count	Mean	Std. Dev.	Std. Error
bulk	20	.850	1.496	.335
naked	20	56.900	47.339	10.585
wrap	20	15.950	18.780	4.199

Duncan New Multiple Range
Effect: pack
Dependent: leafminers
Significance level: .05

	Count	Mean			
bulk	20	.850	a		
wrap	20	15.950		b	
naked	20	56.900			c

All were significantly different at this level.

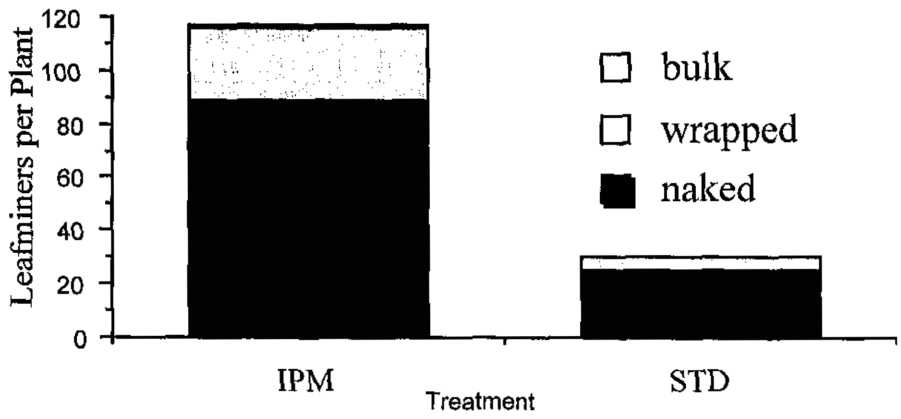


Figure 1. Mean number of leafminers by pesticide regime and pack type ± SE from the Blanco site.

RESULTS

TABLE 4. Pesticide Treatments for Spreckels Head Lettuce

Date	Standard	IPM
7-14-98 Ground	Orthene 1 lb/ac Stryker 3 oz/ac Agrimek 6 oz/ac Manex 3 pt./ac Nufilm-P 4 oz	Provado 3.75 oz/ac Success 6 oz/ac Neemix 6 oz/ac Manex 3 pt./ac Nufilm-P 4 oz/ac
7-31-98 Ground	Ammo EC 5 oz/ac Dimethoate 4E 0.5 pt/ac Agrimek 8 oz/ac Manex 3 pt/ac Kinetic 3 oz	Confirm 8 oz/ac Provado 3.75 oz/ac Neemix 4.5 4 oz/ac Manex 3 pt/ac Kinetic 3 oz
8-12-98	Ammo EC 4 oz/ac Dimethoate Nutriphite Kinetic	Success 5 oz/ac Provado 3.75oz/ac Nutriphite Kinetic 4 oz

TABLE 5. ANOVA results for Spreckels Head Lettuce **Type III Sums of Squares**

Source	df	Sum of Squares	Mean Square	F-Value	P-Value
Treatment * pack	2	5150.821	2575.411	.994	.3801
Treatment	1	1422.822	1422.822	.549	.4635
pack	2	131243.619	65621.809	25.338	.0001
rep	9	12503.915	1389.324	.536	.8378
Residual	35	90645.118	2589.861		

Dependent: leafminers

Means Table
Effect: Treatment * pack
Dependent: leafminers

	Count	Mean	Std. Dev.	Std. Error
IPM, bulk	5	14.800	13.882	6.208
IPM, naked	9	117.667	72.660	24.220
IPM, wrap	10	44.100	35.426	11.203
STD, bulk	6	6.167	5.269	2.151
STD, naked	10	157.500	67.635	21.388
STD, wrap	10	54.000	28.941	9.152

Means Table
Effect: Treatment
Dependent: leafminers

	Count	Mean	Std. Dev.	Std. Error
IPM	24	65.583	64.682	13.203
STD	26	82.769	76.988	15.099

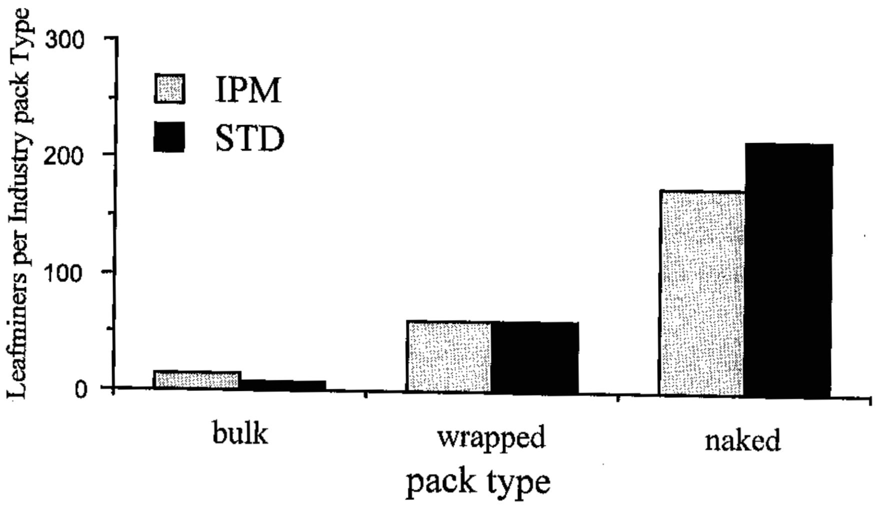
Means Table
Effect: pack
Dependent: leafminers

	Count	Mean	Std. Dev.	Std. Error
bulk	11	10.091	10.549	3.181
naked	19	138.632	71.072	16.305
wrap	20	49.050	31.890	7.131

Duncan New Multiple Range
Effect: pack
Dependent: leafminers
Significance level: .05

	Count	Mean			
bulk	11	10.091	a		
wrap	20	49.050		b	
naked	19	138.632			c

All were significantly different at this level.



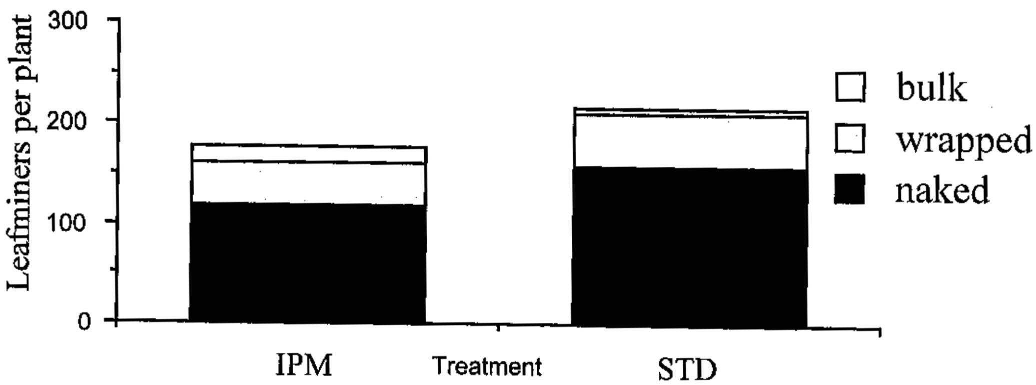


Figure 2. Mean number of leafminers per pack type ± SE from the Spreckels site.

RESULTS

TABLE 6. Pesticide Treatments for Castroville Head Lettuce

Date	Standard	IPM
July 12, 1998 75 gal/acre with surfactant by ground	Ambush 25W 6 oz/ac Agrimek 6 oz/ac Orthene 75WSP 1 lb/ac Ronilan 2 lb/ac	Crymax 1 lb/ac Agrimek 6 oz/ac Ronilan 2lb/ac Nutriphite 2 pt./ac Manex 1.5 qt./ac
July 22, 1998 50 gal/acre with surfactant by ground	Ambush 8oz/ac Agrimek 8oz/ac Confirm 8 oz/ac Manex 1.5 qt./ac Nutriphite 3 pt./ac	Success 4 oz/ac Agri-Mek 8 oz/ac Provado 3.75 oz/ac Manex 1.5 qt./ac Nutriphite 3 pt./ac
August 4, 1998 50 gal/acre with surfactant by ground	Ambush 8 oz/ac Lannate 0.50 lb/ac Manex 1.5 qt./ac Nutriphite 3 pt./ac	Success 4 oz/ac Provado 3.75 oz/ac Manex 1.5 qt./ac Nutriphite 3 pt./ac
August 17, 1998 75 gal/acre with surfactant by ground	Ambush 25W 12 oz/ac Aliette WSP 3 lb/ac $KCO_3$2 lb/ac	Aliette 3 lb/ac KCO_3 2 lb/ac

TABLE 7. ANOVA results for Castroville Head Lettuce - Type III Sums of Squares

Source	df	Sum of Squares	Mean Square	F-Value	P-Value
treatment * pack	2	537.851	268.925	.712	.4955
treatment	1	286.690	286.690	.759	.3877
pack	2	26206.502	13103.251	34.702	.0001
rep	1	146.135	146.135	.387	.5367
Residual	50	18879.742	377.595		

Dependent: leafminers

Means Table
Effect: treatment * pack
Dependent: leafminers

	Count	Mean	Std. Dev.	Std. Error
IPM, bulk	10	1.100	2.183	.690
IPM, wrap	9	7.333	7.778	2.593
IPM, naked	9	55.778	35.096	11.699
STD, bulk	9	1.556	2.920	.973
STD, wrap	10	6.200	4.590	1.451
STD, naked	10	42.800	30.528	9.654

Means Table
Effect: treatment
Dependent: leafminers

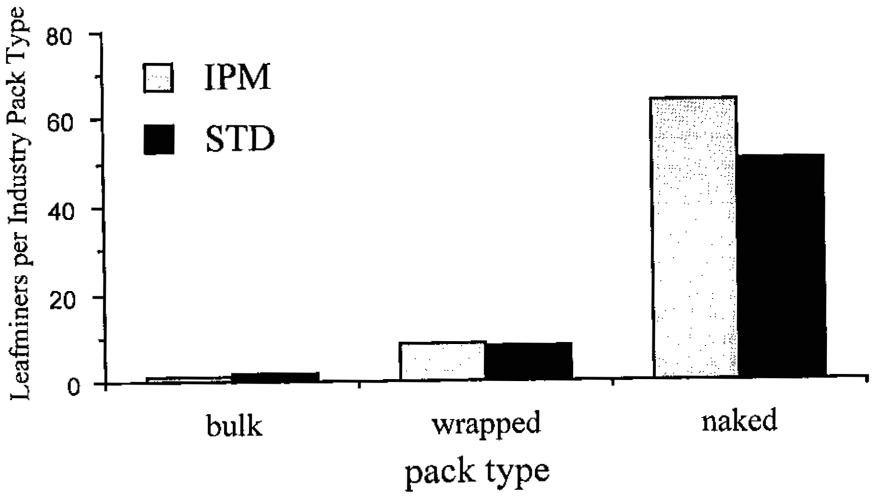
	Count	Mean	Std. Dev.	Std. Error
IPM	28	20.679	31.567	5.966
STD	29	17.379	25.781	4.787

Means Table
Effect: pack
Dependent: leafminers

	Count	Mean	Std. Dev.	Std. Error
bulk	19	1.316	2.496	.573
wrap	19	6.737	6.145	1.410
naked	19	48.947	32.523	7.461

Duncan New Multiple Range
Effect: pack
Dependent: leafminers
Significance level: .05

	Count	Mean		
bulk	19	1.316	a	
wrap	19	6.737	a	
naked	19	48.947		b



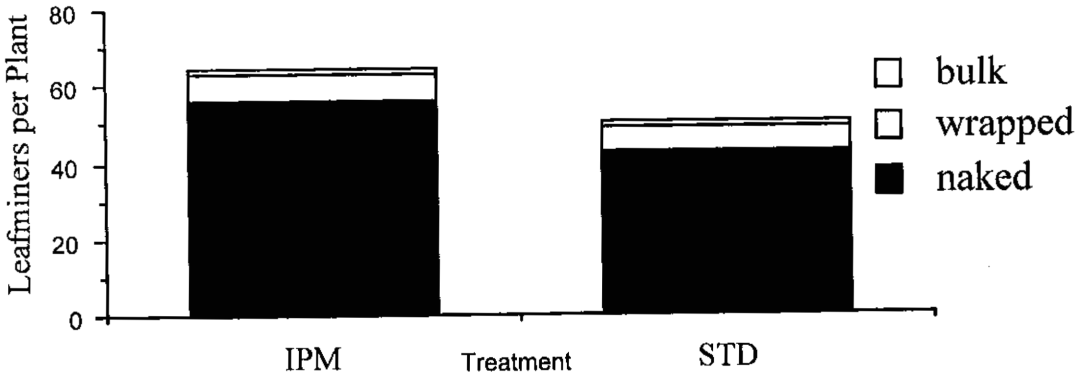


Figure 3. Mean number of leafminers per pack type ± SE from the Castroville site.

RESULTS

TABLE 8. Pesticide Treatments for King City Head Lettuce

Date	Standard Rate/acre	IPM Rate/acre
8-19-98 75 gal. by ground	Dimethoate 0.5 pt. Larvin 30 oz.	Success 5 oz. Dipel 1 lb.
9-1-98 75 gal. by ground	Pounce .75 lb Lannate 1 lb Maneb 2 lbs.	Pyrellin 2 pt. Confirm 8 oz Maneb 2 lbs.
9-9-98 75 gal. by ground	Provado 3.75 Asana 8 oz. Confirm 8 oz. Maneb 2 lbs.	Provado 3.75 oz Dipel 1 lb. Confirm 8 oz Maneb 2 lbs.
9-18-98 75 gal. by ground	Pounce .75 lb. Mustang 4 oz.	Success 5 oz. Crymax 1.5 lb.

Type III Sums of Squares

Source	df	Sum of Squares	Mean Square	F-Value	P-Value
treatment * pack	2	76.931	38.466	4.322	.0185
treatment	1	50.124	50.124	5.632	.0214
pack	2	182.484	91.242	10.251	.0002
rep	1	9.334	9.334	1.049	.3106
Residual	51	453.922	8.900		

Dependent: leafminers

Means Table
Effect: treatment * pack
Dependent leafminers

	Count	Mean	Std. Dev.	Std. Error
IPM, bulk	9	0.000	0.000	0.000
IPM, wrap	10	.500	.972	.307
IPM, naked	10	1.600	2.503	.792
STD, bulk	10	.400	.699	.221
STD, wrap	10	.600	.966	.306
STD, naked	9	6.778	6.942	2.314

Means Table
Effect: treatment
Dependent: leafminers

	Count	Mean	Std. Dev.	Std. Error
IPM	29	.724	1.667	.310
STD	29	2.448	4.793	.890

Means Table
Effect: pack
Dependent: leafminers

	Count	Mean	Std. Dev.	Std. Error
bulk	19	.211	.535	.123
wrap	20	.550	.945	.211
naked	19	4.053	5.622	1.290

Duncan New Multiple Range
Effect: treatment
Dependent: leafminers
Significance level: .05

	Count	Mean		
IPM	29	.724	a	
STD	29	2.448		b

All were significantly different at thi s level.

Duncan New Multiple Range
Effect: pack
Dependent: leafminers
Significance level: .05

	Count	Mean		
bulk	19	.211	a	
wrap	20	.550	a	
naked	19	4.053		b

TABLE 9. ANOVA – Results for King City Head Lettuce

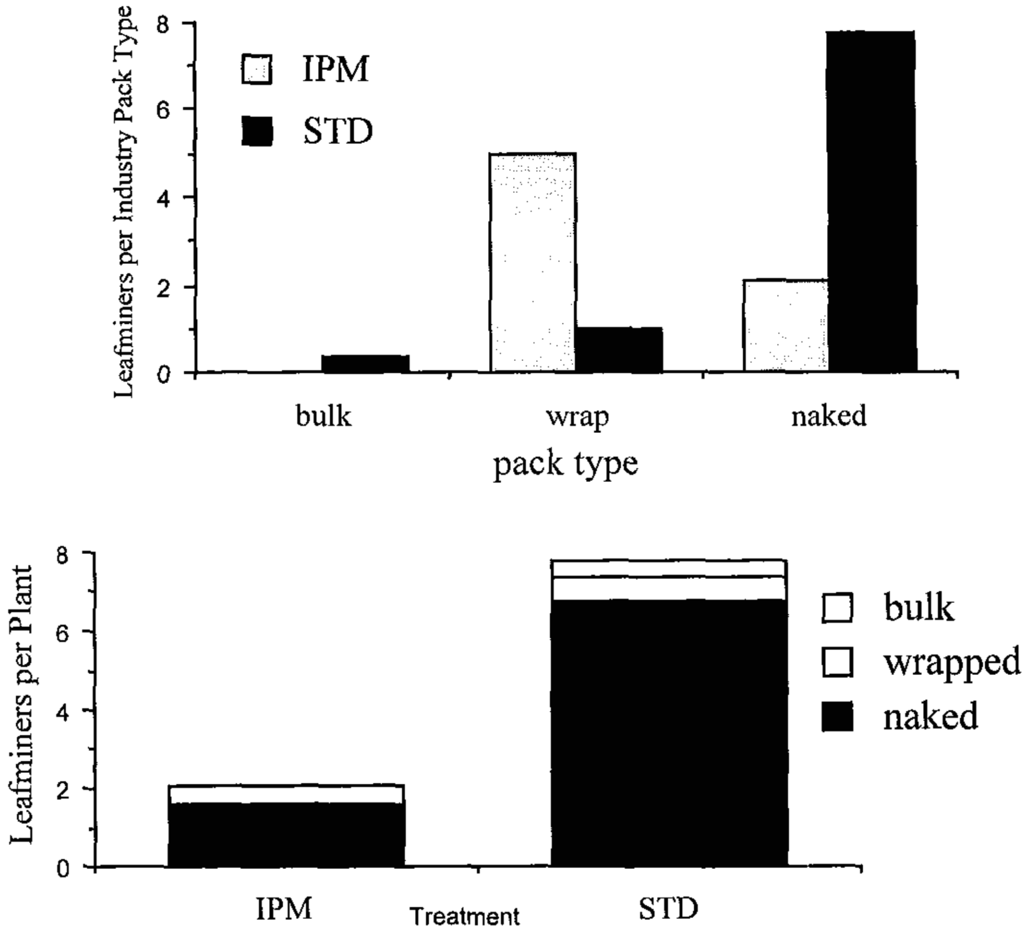


Figure 4. Mean number of leafminers per pack type ± SE from the King City site

RESULTS AND DISCUSSION

The numbers of leafminers emerging from the different head lettuce pack types were significantly different from each other. Two to six times as many leafminers emerged from the outer leaves as from the rest of the sample. Leafminers emerged from the bulk pack (figures 1, 2, 3, and 4) at all sites. The impact of the two pesticide regimes was less clear. The STD and IPM pesticide regimes did not consistently impact the number of leafminers emerging per sample as shown in the ANOVA tables (tables 3, 5, 7 and 9). This was despite the differences in leafminer control materials (tables 2, 4, 6 and 8). Two sites where the number of leafminers emerging differed between treatments gave contradictory results; the Blanco showed the IPM treatment more infested than Standard but the King City site was opposite.

SUMMARY AND CONCLUSIONS

Despite different pesticide regimes, leafminers are infesting outer leaves more heavily than inner leaves. As the lettuce industry moves away from naked pack to wrapped, and bulk, more of the leafminers will be left in the field. Other research conducted by the Entomology Farm Advisor suggests that these leafminers left in the field can be reduced by timely flail chopping the crop residue immediately after harvest.

LEAFMINER PROJECT
TASK 3, SUBTASK B - PURPOSE: TO SUPPLEMENT THE EFFORTS OF THE CENTRAL COAST VEGETABLE IPM PROGRAM IN SANTA MARIA

INTRODUCTION

Leafminers have been the predominate insect pest in iceberg and leaf lettuce in the coastal and central coastal valleys of California during the last ten years. Populations became so high that no insecticide program was effective and quality was being compromised. In 1997, the CLRB, in conjunction with local lettuce and celery producers, the private sector (both pest control companies and pest control advisors) and the University of California Cooperative Extension, formed a multi-organizational cooperative program to develop control strategies for this pest. The emphasis was on reducing the amount of chemical pesticide applied combine with the increased use of alternative control measures. This group was funded by the Pew Charitable Trusts for a three-year demonstration and implementation program called the Central Coast Vegetable IPM Program (CCVIPMP), supplementing the CLRB funded research program.

The purpose of this work was to supplement the efforts of the CCVIPMP in helping to expand their work into the Santa Maria area. This was accomplished by holding an informational meeting in this area. This meeting was held on March 30, 1999 and was attended by approximately 85 PCA's and growers. Interest was very high in both the previous CCVIPMP and CLRB work. There was also considerable interest in potential trials being established in their area and in the new aphid pest, *Nasonovia ribis-nigri*, the lettuce aphid.

This meeting helped facilitate the second objective of this subtask, establishment of demonstration plots in the area with local PCA's. Two such trials were initiated, one with a cooperating PCA from Simplot and one with a PCA from Western Farm Service (WFS). Unfortunately, the plot with the WFS PCA received two pesticide treatments in which the materials were applied to the wrong areas of the field. This was after one application had already been made as designed. It was decided to that data from this field would be meaningless, and the trial was abandoned. The data collected prior to discovery of the error was discarded.

MATERIALS AND METHODS

The field had been divided into "treatments" that were subjected to either 'IPM' or 'Grower Standard' pesticide regimes as outlined below. The two pesticide regimes were chosen by the PCA for each field from pesticide menus as shown in Table 1, which had been developed by the management team of the CCVIPMP. Spray records from individual fields are presented in the Results section along with data analysis.

TABLE 1. Insecticide menu by pest for "Standard" and "IPM" head lettuce treatments

Pest	**"Standard"**	**"IPM"**
Pea Leafminer Larvae	Agrimek Dimethoate Neemix Success Trigard	Agrimek Neemix Success Trigard
Pea Leafminer Adults	Pyrethroids	No treatments
Aphids	Admire Provado Diazinon Dimethoate Lannate Orthene	Admire Provado Orthene♦
Loopers **Armyworms** **Corn Earworms**	Bts Confirm Lannate Larvin Pyrethroids Success	Bts Confirm Success Larvin♦
Lygus	Pyrethroids	Pyrethroids♦

♦ Indicates materials, which may be used in "IPM" *if* pest reaches economic thresholds.

DATA COLLECTION

Insect pests and natural enemies were monitored weekly by the cooperating PCA. In addition, the CCVIPM staff monitored the field the day prior to harvest. Forty plants per field, 20 from the IPM side and 20 from the Standard side were monitored and data recorded from each plant. For each sample, a head was cut and each leaf is stripped and inspected for any insect damage including leafminer mining, aphids, worms, or lygus damage. The total number of mined leaves per plant was recorded for leafminer monitoring. For aphids, the type of aphid, alate ("flyer") or apterous (wingless), the species (where possible), and a rating based on the population level was recorded.

Natural enemy monitoring consisted of in-field counts and "bucket samples." Bucket samples measured larval leafminer and parasite populations via counts of adult leafminers, and leafminer parasitoids that emerged and stuck to a yellow sticky card inside the bucket. Plant samples of whole lettuce heads were taken from the field, placed in the bucket with the yellow sticky card, covered, and left for 6-8 weeks. Leafminer larvae and leafminer parasitoids developed during this time, emerged, flew to and got trapped on the sticky card.

HARVEST DATA:
Quality and yield comparisons between the IPM and Standard treatments are some of the most important data collected. However, market volatility and the numerous types of packs commercially harvested (export, food service, wrapped, naked, 24's, 30's, etc) made obtaining comparable data between the two sides challenging. This is why two types of harvest data were collected: from small plots and from commercial harvest.

The small plots were randomly selected across the field, and were 15 feet long and three beds (40 inch beds) wide. A total of 6 small plots of each treatment from replicated fields were harvested. On the day of harvest, a person from the commercial harvest crew was asked to cut all of the marketable lettuce from the small plots. The cutter cut whatever the crew was harvesting commercially that day, wrapped pack or naked. The same person was used to harvest all of the plots and was not told what the difference was between the sides. The cutter determined the size of the lettuce head or if should be rejected and why. Heads were rejected due to size, softness (puffy), or specific insect or disease damage. In this way, each head within the small plot area was accounted for; it was either harvested for 24, 30 or sometimes 38-pack, or rejected and not harvested. The number of heads harvested from the small plots was then used to estimate cartons harvested per acre.

Commercial harvest data, (carton counts from the machines), was also collected from the field trial. The cooperating grower volunteered to collect the harvest data themselves. They also weighed 10 cartons of each pack from each area. Yield in cartons/acre was calculated from the length of the pass and the machine width from which the harvest was taken.

The cooperator for this trial was Owen T Rice & Son, Inc. The PCA was Daniel Mead. The field was located on the Rice & Son, Inc. Ranch 3 in Santa Maria and the variety was Ponderosa, a head lettuce variety. The field was planted on March 5, 1999; scheduled to harvest on May 25, 1999; harvest actually began June 1, 1999. The field was farmed as a 40-inch bed system with two seedlines/bed. There were 36 beds or 5.5 acres treated with the standard pesticide regime and IPM was used on an area 24 beds wide or about 3.7acres. The trial covered a total of 9.2 acres.

The following table shows the specific insecticide treatments and rates applied for this trial.

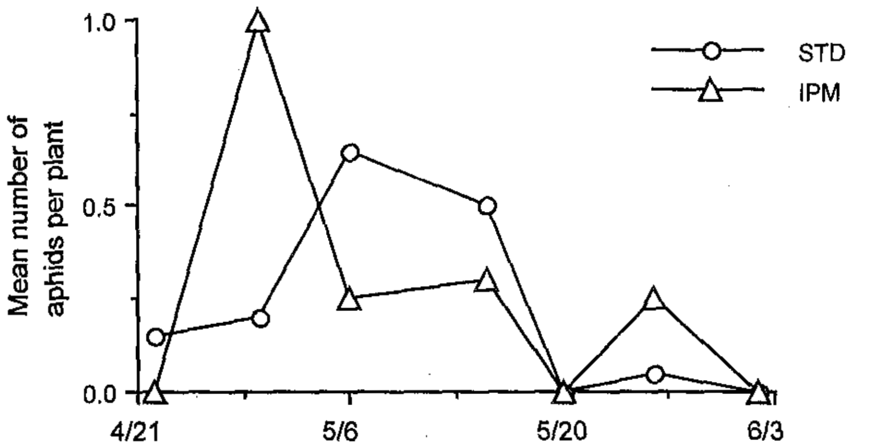
TABLE 2. CCVIPM 1999 Field Trial - Santa Maria Head Lettuce - Pesticide Treatments

Date	**Standard** **rate/ac**	**IPM** **rate/ac**
04/27/99 50 gal/acre	**Orthene 75WSP** 1.25 lb. Rovral fungicide 2 lbs Maneb 75DF 2 lbs Aliette WDG 2 lbs CMR spreader sticker 8.0 oz	**Provado 1.6 F** 3.75 fl oz. **Success** 4 fl oz Rovral fungicide 2 lbs Maneb 75DF 2 lbs Aliette WDG 2 lbs CMR spreader sticker 8.0 oz
05/6/99 by ground 50 gal/acre	**Provado 1.6 F** 3.75 fl oz. **Success** 5.0 fl oz Maneb 75DF 2 lbs Nutri Phite 64oz CMR spreader sticker 8.0 oz	**Provado 1.6 F** 3.75 fl oz. **Success** 5.0 fl oz Maneb 75DF 2 lbs Nutri Phite 64oz CMR spreader sticker 8.0 oz
5/28/99 by ground 50 gal/acre	**Pounce WDG** 0.7 lbs Nutri Phite 64oz No Foam B 8 oz	**Success 5** oz. Nutri Phite 64oz No Foam B 8 oz

RESULTS AND DISCUSSION

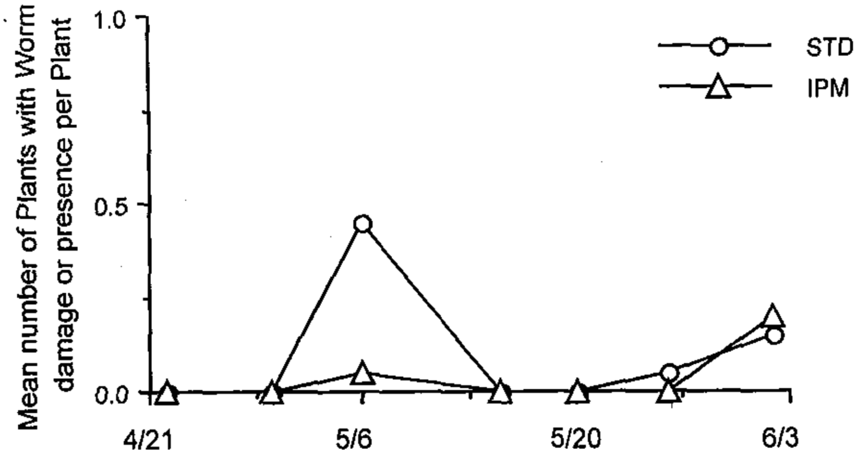
Very few leafminers were present in this field during the study. There was some pressure from both aphids and worms. The following graph shows the mean total number of aphids per plant on each of the sample dates. Note that the populations under neither treatment regime ever exceed a mean of 1 aphid per plant. These aphids were mostly the green peach aphid, *Myzus persicae*. The Lettuce aphid was not present in this field.

Figure 1. Mean number of Aphids per plant



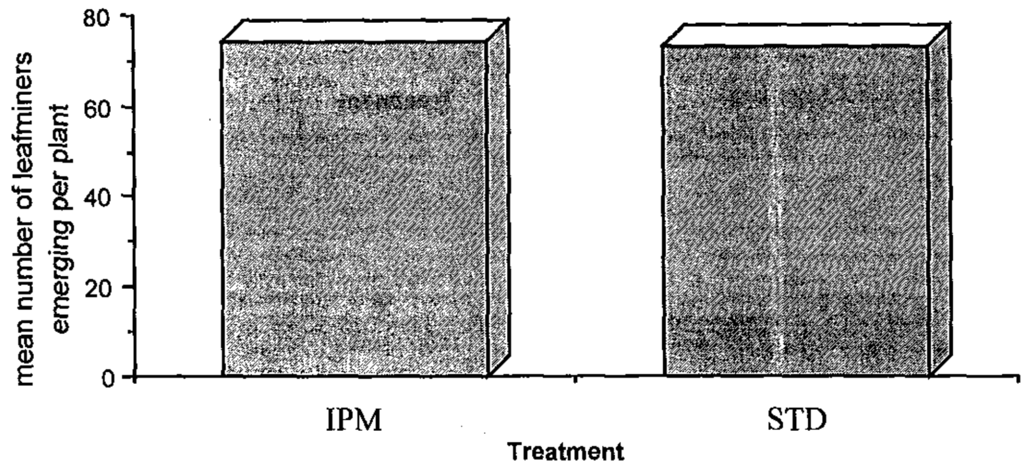
The following graph shows the mean number of plants (in the sample of 20) with worms or worm damage on each of the sample dates. The worms were mostly loopers, ether cabbage looper or alfalfa looper. The populations were again low with a maximum of 2.5% infested heads (0.5 plants in 20).

Figure 2. Mean number of plants with worm damage or presence per plant



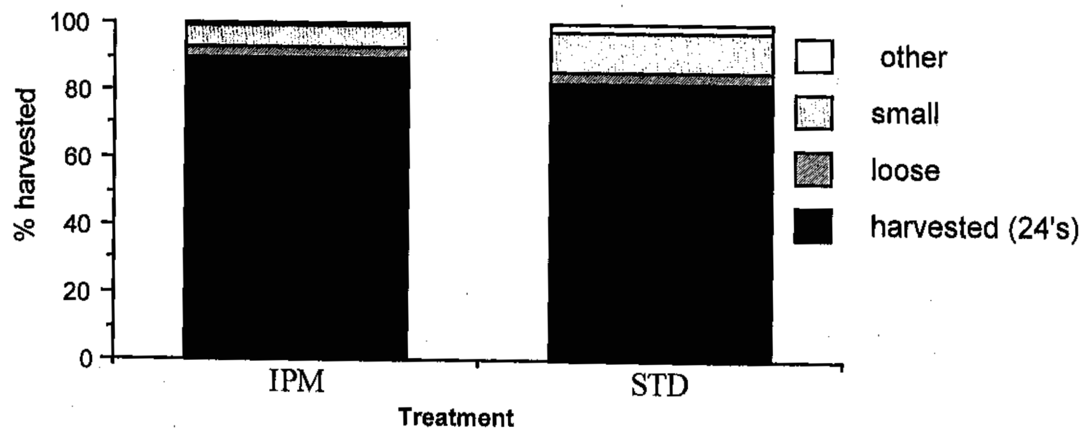
The following graph shows mean number of adult leafminers obtained from the bucket samples. Graphed is the mean number of adult leafminers per head of lettuce for each monitoring date. As you can see there were no differences between to the two treatments. There were too few parasites found in this field to present results graphically and no differences were seen between the two treatment regimes. The mean of approximately 80 leafminer adults per head is considered a low to moderate infestation. Heavy infestations would produce 300 to 400 leafminer adults per head.

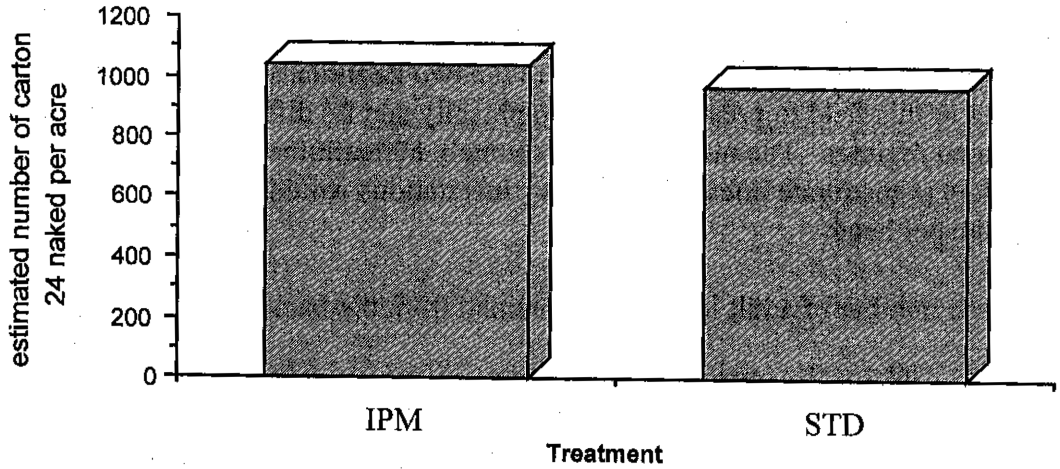
Figure 3. Mean number of adult leafminers obtained from the bucket samples

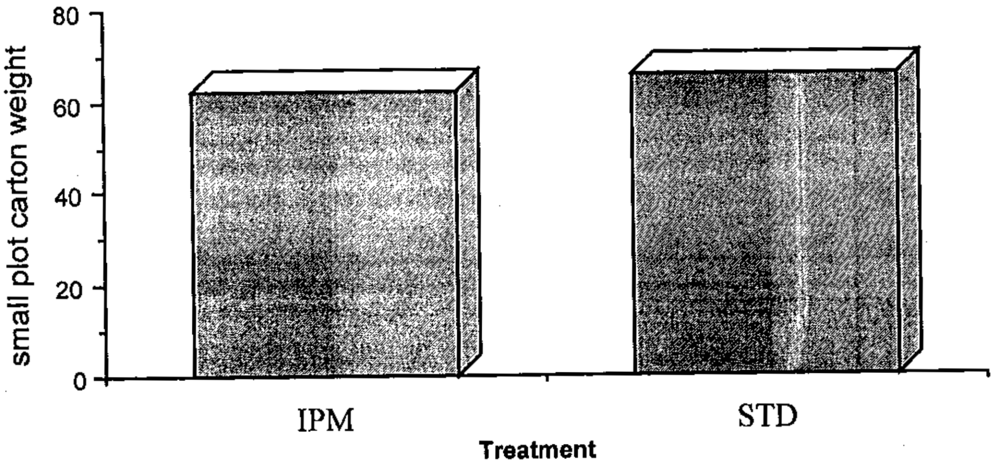


The data from the small plot harvest are presented in the 3 graphs below. The first depicts the fate of each head in the small plot as a percentage of the total, the second is the estimated yield in cartons/acre and the third is the mean carton weights of naked 24-pack lettuce for the two treatments. There were fewer small and loose heads in the IPM treatment compared to the standard, but this was due to an area of the field with a nutritional or irrigation problem.

Figure 4. % Harvested

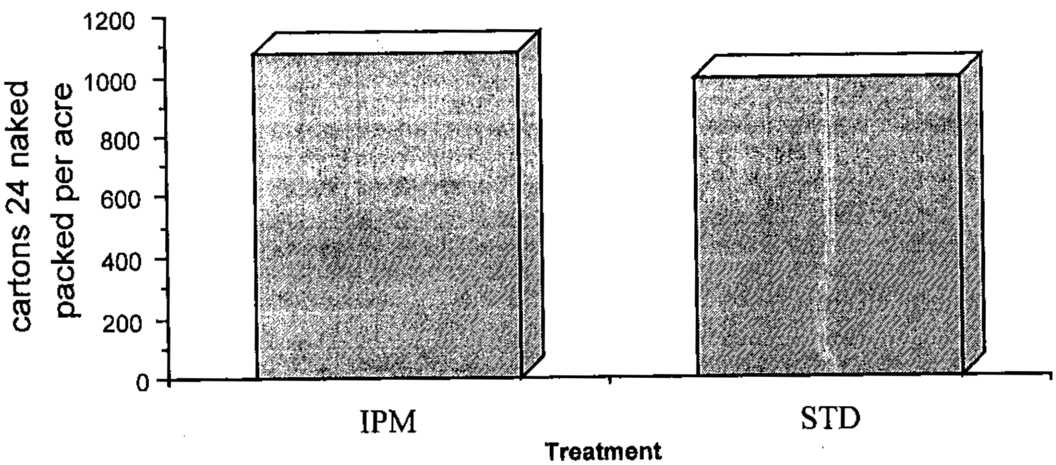


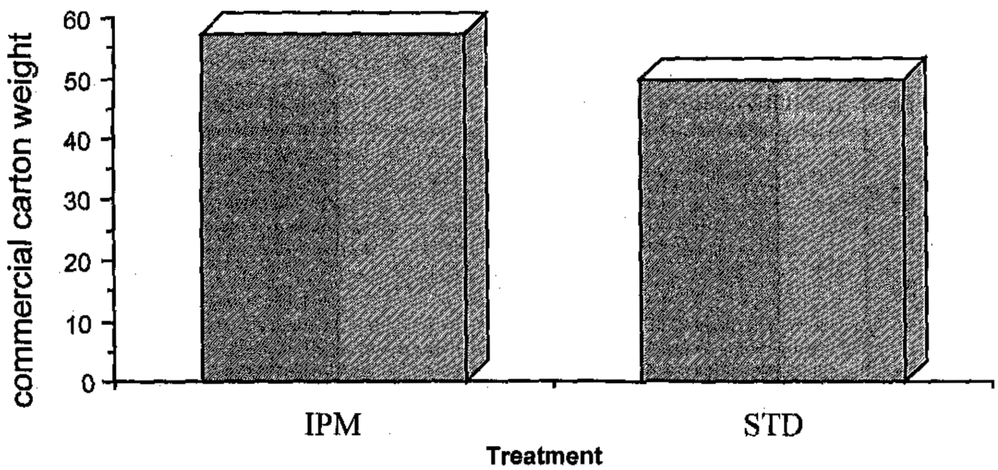




The final two graphs present the commercial harvest data from field trial in terms of the yield in cartons per acre and the mean carton weight for a naked 24 carton. The cooperating grower collected his data from the harvest machines. The slight difference in the number of cartons can be attributed to the larger percentage of small and loose heads in one area of this treatment.

Figure 5. Cartons 24 naked packed per acre





SUMMARY AND CONCLUSIONS

In this trial, there was one less insecticide applied to the IPM side as compared to the standard side, and there were no pyrethroids or organophosphates applied to the IPM side. Despite these different pesticide regimes, there were no significant differences in the pest pressure, beneficial insect populations (too low to be presented here) or in the quantity or quality of the lettuce harvested. This is consistent with the results seen in the field trials conducted in the Salinas Valley.

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FINAL REPORT SIGN-OFF SHEET

This report was approved by the contract manager

Contract Manager
Date:

This report was scanned for virus, and copied to the I drive. A photocopy was made for Anne.(disk is filed in grants cabinet)

Sewell Simmons

Sewell Simmons
Date: ____________________

This report has been formatted, and edited for any obvious errors, (not to include any content changes.)

Anne M. Mox

Anne Mox
Date: Feb. 17, 2000 97-0282

This report is ready to be placed on the web.

Sewell Simmons
Date: ____________________